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## **Global Challenges and the Need for Supranational Infrastructure**

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# **GLOBAL CHALLENGES AND THE NEED FOR SUPRANATIONAL INFRASTRUCTURE<sup>1</sup>**

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Dating back to Adam Smith, economists have recognized that a well-functioning market system needs some government-provided activities in terms of a justice system, laws, national defense, and public goods (e.g., roads, schools, police). Many of these government activities represent the infrastructure, or basic underlying framework, that promotes the operation of markets where traders voluntarily exchange their property rights to goods and services in their pursuit of mutual gains. For example, laws, police forces, and courts provide for the protection and enforcement of property rights, without which market transactions would be severely limited (see, e.g., Demsetz, 1964; Pejovich, 1990). Why purchase or provide a commodity if the control over its benefits cannot be decided by the purchaser or provider? When property rights are incompletely exercised by the provider, the good is often underproduced and suboptimal resource allocation results. Pure public goods, which possess nonexcludable and nonrival benefits,<sup>2</sup> are often underprovided (Bator, 1958), insofar as individuals have an incentive either not to pay or to underpay for the goods. By so doing, the individual is characterized as taking a free ride or easy ride on the amounts contributed by others.

In a provocative paper, "Big Bills Left on the Sidewalk...", Mancur Olson (1996) attributes the poverty of nations to ill-conceived institutions and policies instead of a lack of resources. These poorly designed institutions and policies yield the wrong incentives to economic agents whose actions do not sufficiently further the well-being of the economy. According to Olson

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<sup>1</sup> While assuming full responsibility for any remaining errors, I have profited from comments by Geoffrey Heal and Anthony Lanyi on an earlier draft.

<sup>2</sup> On the definition and properties of public goods, see Cornes and Sandler (1996, 8-12) or Sandler (1992, 3-7).

(1996), the improvement of these policies and institutions through better governance can lead to the big bills on the sidewalk being real – the possibility to achieve social welfare gains. Market-augmenting governance is a policy that can improve social welfare by allowing prices and profits to signal correctly the direction of resource allocation (Azfar, Cadwell, and Olson, 1999). Social infrastructure, along the lines of Adam Smith's roles for government, consists of activities and institutions that increase social welfare by enhancing market transactions. This infrastructure serves as a public input that can enhance the production and trading activities in the public and private sector.<sup>3</sup> The notion of market-augmenting governance also applies at the supranational level at which nations and/or multilateral agents (e.g., multilateral firms) are participants in exchanges.

The world today is besieged by market failures at the transnational level. These failures involve the provision of public goods (e.g., curbing global warming, maintaining world peace, stemming acid rain), the correction of externalities (e.g., controlling organized crime), and the enforcement of property rights. If the global community is to address adequately these market failures, then some kinds of supranational infrastructure are required to facilitate the appropriate correction. Even when international market exchanges occur, the underlying conditions that enforce and protect property rights must be in place at the supranational level. The provision of this infrastructure (e.g., an enforcement mechanism for contracts) poses greater obstacles at the supranational than at the national level. In the latter, subnational governmental units institutionally accept that they must subjugate their authority on some issues to a central government that attempts to correct market failures. At the supranational level, however, nations vigorously guard their autonomy and are loathed to sacrifice their revenue collecting, policy making, or security operations to a higher authority. The world today still consists of nations that try to remain autonomous over most of their exchanges (Kindleberger, 1986; Sandler, 1997).

The provision of supranational infrastructure and policies faces some serious challenges. Often, incentives for voluntarily providing this infrastructure are perverse in terms of free-riding difficulties in which a nation is better off if it can limit its contributions and rely on those of others (Olson, 1965). For some global contingencies, a large number of participants are needed and this

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<sup>3</sup> An input is public if it enters two or more agents' production functions and yields production benefits that are nonrival and nonexcludable. Nonrivalry and nonexcludability may be full or partial. Social capital or infrastructure serves as a public input by

critical-mass requirement may inhibit collective action (Dixit and Olson, 1997; Hardin, 1982; Marwell and Oliver, 1993; Olson, 1965; Sandler, 1992). In still other scenarios, there may exist both winners and losers from the provision of some forms of supranational infrastructure, and these losers will surely oppose provision. The transaction costs associated with achieving agreement on supranational infrastructure are apt to be high, thus further inhibiting successful bargaining regarding provision (Dixit, 1996; Dixit and Olson, 1997; Sandler, 1997). Asymmetries abound in terms of the provision of supranational infrastructure, making it difficult to reach a consensus as nations differ in terms of their endowments, status, and information. For instance, information asymmetries between principals (e.g., nations) and their agents (e.g., international organizations), which act to correct market failures, can give rise to agency costs.<sup>4</sup> These agency costs, required to motivate risk sharing between the agent and principals, represent transaction costs that can result in third-best or worse outcomes.<sup>5</sup>

The primary purpose of this paper is to analyze market-augmenting *and* market-failure-correcting policies in the form of supranational infrastructure. In so doing, this paper considers the use of this infrastructure to address some market failures or transnational externalities whose corrections are not directly market augmenting, though they may indirectly create favorable conditions for markets to operate – e.g., bringing peace to an unstable region can promote capital inflows. Thus, supranational infrastructure may augment markets and/or correct market failures. When presenting this analysis, I identify and clarify the factors that inhibit this provision at the transnational level. Additionally, the means for fostering the provision of supranational infrastructure are put forward. In some areas (e.g., shipping, telecommunications, postal services, air travel), the required infrastructure in the form of conventions and allocative mechanisms have naturally developed (Zacher, 1996); hence, favorable environmental factors can assist some types of supranational infrastructure.<sup>6</sup> The paper is intended as a conceptual exercise to highlight the

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increasing firms' outputs. On public inputs, see Manning, Markusen, and McMillan (1985) and McMillan (1979).

<sup>4</sup> At other times, a country may be an agent for an international organization as occurs when a country tries to fulfill commitments associated with an International Monetary Fund (IMF) loan.

<sup>5</sup> Dixit (1996) characterizes economic policy making as a common-agency problem, where two or more principals share one or more agents, who may possess information not available to the principals. Common-agency problems suffer from both agency costs and free-riding problems. The latter stems from the principals' incentive to pass the agency costs onto their counterparts.

<sup>6</sup> This chapter presents an economist's viewpoint of supranational infrastructure, while taking account of some related contributions by political scientists. There is a vast literature in political science on international regimes where the emphasis has been on power, as in the case of hegemonic stability theory (Keohane, 1984). Others have examined the formation of these

need for supranational infrastructure in an increasingly interconnected world of sovereign states. Regions of the world that are more effective at instituting market-enhancing and efficiency-enhancing policies regarding transnational infrastructure fare better than other regions. Olson's (1996) message with respect to the relative difference between nations' growth and prosperity can clearly be applied to regional groupings of nations.

## 1. GLOBAL CHALLENGES: MARKETS AND MARKET FAILURES

### *On Markets and Market-Augmenting Infrastructure*

Although there has been a growing disparity between the income levels of the richest countries and those of the poorest countries,<sup>7</sup> a number of less developed countries, particularly in Asia, have greatly improved their well-being (Jones, 1997). These emerging-market economies have added to the world's growth of markets. The breakup of the Soviet Union and its client states, along with their ongoing transition to more market-based economies, have bolstered the trend to a greater reliance on markets worldwide in recent years. The relaxation of some trade restrictions have also reinforced this trend by allowing for freer international exchanges of goods, services, and capital. Clearly, the end to the Cold War has reduced some security uncertainties, thereby leading to a significant decline in defense spending. For example, NATO allies allocated approximately 5.0 percent of gross domestic product (GDP) to defense in the 1980s, while these same allies spent only 2.7 percent of GDP on defense in 1997 (NATO Office of Information and Press, 1995, Table 3, p. 359; NATO, 1997). Similar downward trends apply to most parts of the world (Arms Control and Disarmament Agency, 1997). Since government distortions (e.g., subsidies to defense R & D) and monopoly elements characterize the defense industry (Sandler and Hartley, 1999), the significant declines in defense spending and procurement also support the recent growth of markets.

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regimes in terms of mutually beneficial bargaining and/or leadership (see, e.g., Keohane, 1984; Krasner, 1983; and Young, 1989). In contrast to this literature, the current paper is interested in displaying the underlying game structure of regime building and the means for fostering incentives in such regimes. Additionally, the paper is specifically focused on supranational infrastructure, which is not the concern of much of the related political science literature.

<sup>7</sup> Between 1960 and 1994, the richest fifth of all nations had their share of world income rise from 70 percent to 85.8 percent, while the poorest fifth of all nations had their share fall from 2.3 percent to 1.1 percent (United Nations Development Programme, 1992; 1994, p. 35; 1998).

If this international growth of markets is to achieve its full potential impact on the world's social welfare, infrastructure at the transnational level must facilitate these market transactions. A number of crucial pieces of infrastructure, however, are still missing at the international level and their absence limits efficiency gains. Better means for enforcing property rights to intellectual goods represent market-augmenting infrastructure and are needed if such goods are not to be underproduced. Currently, those countries that are the greatest producers of intellectual goods – computer programs, books, movies, compact discs – are understandably the ones that are pushing the hardest for more uniform enforcement of intellectual property rights worldwide; but these countries' efforts have not always been effective or coordinated. The protection of these property rights poses a challenging collective action problem because there are both winners (those who create the intellectual goods) and losers (e.g., those who pirate them).<sup>8</sup> The underprovision of such goods not only hurts the current generation through suboptimal production, but also it harms future generations who may not inherit potential discoveries. In fact, intellectual goods will always be underproduced from an intergenerational perspective insofar as the gains conferred on future generations, particularly distant ones, cannot really be appropriated owing to the sequencing of generations (see, e.g., Bromley, 1989; Doeleman and Sandler, 1998). The practice of discounting future benefits means that little actual benefits are assigned to future generations even if their benefits were recognized by a generation in the process of providing an intergenerational public good or input.<sup>9</sup> Altruism offsets this tendency if the altruistic generation does not apply a discount factor to spillover benefits conferred on future generations from a public asset produced today. Nevertheless, mechanisms and conventions to protect these intellectual goods transnationally can do much to promote efficiency, even though a first best remains unattainable.

At the international level, another market-promoting infrastructure is a set of standards of contracts founded on accepted principles of contract law. In particular, transitional and emerging-

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<sup>8</sup> The portion of winners and losers can change over time. As poorer countries develop, there will be a greater number of winners from protecting intellectual property rights. It is important to remember that as the underlying conditions of international participants and the environment alter, the incentives behind supranational infrastructure and, hence, its design can change.

<sup>9</sup> The issue of the underprovision of these long-lived public goods and the appropriate rate of discounting is complex and unresolved. Even a small discount rate can greatly diminish distant benefits of these intergenerational public goods so that smaller levels of provision will be forthcoming. Some researchers (e.g., Sandler and Smith, 1976) have argued for a zero discount rate, while others (e.g., Heal, 1997) have made a convincing case for a proportional rather than exponential rate of discounting. Unlike most physical capital, some intellectual and environment capital have exceedingly long lifetimes, indicating the need for an alternative discount practice. The proper rate of discount is beyond the scope of this paper.

market economies must adopt contractual standards modeled after those in the developed world to protect property rights in a sufficiently unambiguous manner. This is probably a self-correcting problem because it is in these countries' self-interest to abide by accepted standards even when this means sacrificing some autonomy in framing these standards. There is a related infrastructure concern that poses potential difficulties in today's environment of multinational actors and multilateral exchanges, which involves where a party takes a case to be adjudicated when contract disputes arise. If a party can choose the venue or country where the case is heard, then the party can exercise a strategic advantage (e.g., electing to hold the trial in the country furthest away from the other party or else making its base where laws are favorable to its interests). To get more uniform judgments and to limit strategic behavior, an international network of courts, devoted to property right disputes among nonstate agents engaged in multilateral exchanges, should be instituted. The World Court and World Trade Organization settle disputes between nation-states and are *not* open to firms or private individuals, which must also resolve contract disputes involving interests and exchanges in two or more countries.

A third required market-augmenting infrastructure involves coordinated efforts to control international networks of organized crime, a growing problem today. Organized crime reduces the importance of property rights and also creates instabilities and uncertainties, which can distort the flow of capital and keep capital returns from equalizing across countries, thereby distorting capital efficiency. Faced with differing standards of enforcement, organized crime (e.g., the Russian "mafia") will locate in those places with the lowest enforcement standard, while posing a threat to the interests of foreigners as well as citizens of the host country. If an organized crime network targets the property of foreign nationals living in the host country, there is apt to be underdeterrence by the local police, who are more concerned with the lives and property of citizens. If, however, the crime network poses a significant threat to the host country's interests (e.g., tourism, foreign direct investment), there may result an overdeterrence that causes the criminals to move to a neighboring country.<sup>10</sup> Overdeterrence results because the externality imposed on the neighboring country as the criminals set up shop elsewhere is not taken into account by the deterrence decision. An international police force to battle such crime networks

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<sup>10</sup> The model in Sandler and Lapan (1988) concerns the choice of targets by terrorists. The same model structure could be applied to study the effects of deterrence on an organized crime network's choice of target and place of operations.

constitutes a market-augmenting policy that limits market-distorting influences on property rights, but is very difficult to achieve as nations are reticent to sacrifice their autonomy over any internal security and policing matters to an international authority. Interpol is a feeble effort to coordinate law enforcement internationally, and, except for coordinating information, has not met with much success.

A fourth market-augmenting infrastructure requirement involves curbing financial market instability that can resonate throughout the world, so that the collapse of a Japanese bank can cause large stock market gyrations half a globe away. The increased integration of financial markets in recent years inevitably means that market instabilities in one location can spill over to markets worldwide (Lanyi and Lee, 1999). To limit these instabilities, economies worldwide must adopt sound and uniform standards of banking, accounting, and investment practices. Many of these practices have been instituted in the industrial countries in response to speculative crashes in the past, and should be adopted by the transitional and emerging-market economies. For example, stock markets worldwide may want to institute safety valves to halt trading on volatile days, not unlike those imposed by Wall Street after Black Monday in October 1987. The institution of improved financial practices worldwide represents a collective action problem as nations evaluate the trade-off between sacrificing their autonomy and the increased stability and trading associated with instituting sounder and more uniform financial practices. Because it is in the interests of these emerging-market economies to institute these financial practices and, moreover, the consequent loss of autonomy is not great, the prognosis is good that such uniform practices will be adopted. The favorable conditions that have promoted uniform conventions in shipping and aviation (see Section 2) also apply to sound financial practices. Even autocrats have incentives to institute these practices to attract capital and increase economic activities from which they can extract taxes. A more difficult collective action dilemma arises when some international authority must be created to monitor and ensure compliance with these practices, because nations worry about sanctions which may later be applied to them. Additionally, the creation of this authority possesses purely public benefits that induces free riding (Heckathorn, 1989).

### ***Market Failures***

In recent years, a host of environmental challenges have involved the stratosphere, the troposphere, the land, the rivers, and the seas (see Heal, 1999). Economic activities in one nation



can transcend borders and have adverse consequences on nations, not party to the transaction. Thus, the emissions of sulfur and nitrogen oxides from burning fossil fuels and driving vehicles can produce acid rain that can fall in downwind countries. Some emissions disperse so widely as to result in global spillovers – e.g., the release of greenhouse gases (GHGs) warms the atmosphere and may have significant climatic consequences. Similarly, the emission of CFCs has thinned the stratosphere ozone layer, thus exposing living things worldwide to heightened levels of ultraviolet radiation. Actions by countries to exploit their natural assets can also affect people globally – e.g., tropical deforestation's impact on biodiversity.<sup>11</sup>

Some market failures of a public good or externality character may not necessarily affect the environment. In the health area, the identification and monitoring of new diseases can benefit people everywhere. If a cure to a disease is found, this cure provides benefits to the current and all future generations. Such a cure is surely an intergenerational global public good and, as such, is likely to be underprovided. Preventing the spread of diseases and pests is an instance of a transnational public good which, without international coordination, is destined to be provided at a suboptimal fashion. Crisis-management and other security concerns can also present market failures in terms of externalities at the transnational level, and thus require some form of supranational infrastructure to avoid a misallocation of resources. Unstable regions of the world that acquire weapons of mass destruction (WMD) create externalities in terms of heightened risks and harmful spillovers from biological, chemical, or nuclear releases. The free flow of capital and other resources may then be inhibited by these arms escalations. The Nuclear Nonproliferation Treaty, the Biological Weapons Convention, and the Chemical Weapons Convention represent the international community's response to this WMD threat (Sandler and Hartley, 1999, Ch. 1); however, events of May 1998 concerning nuclear weapon tests in India and Pakistan underscore the ineffectiveness of these treaties. Yet another security matter concerns the impact of ethnic conflicts on regional and global security and stability. The supranational infrastructure designed to address these security challenges is the UN peacekeeping forces; however, the tremendous expansion of UN peacekeeping missions in recent years stretched UN capabilities to the limit. During the first four decades of the United Nations there were 14

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<sup>11</sup> On these global and regional environmental challenges, see Barrett (1994, 1998), Carraro and Siniscalco (1998), Heal (1997), Helm (1991), and Sandler (1997, 1998).

missions, while during 1988-97 there were 33 new missions (Sandler and Hartley, 1999; United Nations Department of Public Information, 1996). In Bosnia, the United Nations had to eventually turn this complex mission over to NATO's superior forces because UN resources were overextended. In March 1999, NATO, not the United Nations, has intervened to end ethnic cleansing in Kosovo and institute a peace agreement.

These examples represent a rich array of market failures plaguing the world today. A common response to such contingencies is for the global community to frame a treaty that recognizes the problem and pledges the ratifiers to take some kind of action – e.g., the Montreal Protocol on limiting ozone-depleting substances, the Helsinki Protocol on reducing sulfur emissions in Europe. An important question is whether these treaties and other responses by the international community to correct market failures represent an adequate supranational infrastructure.

## 2. SUPRANATIONAL INFRASTRUCTURE

Supranational infrastructure consists of institutions, norms, conventions, or activities that facilitate market transactions and/or alleviate market failures at the transnational level. This infrastructure is, at times, local in its influence as between neighboring countries, while, at other times, it is regional or global in its scope. For market transactions, this infrastructure provides standards for writing and enforcing contracts, or norms for regulating transportation and communications. For market failures, supranational infrastructure consists of agreements, enforcement mechanisms, institutions for coordinating actions, and means for carrying out policy initiatives. It is instructive to first address market-augmenting infrastructure where a good deal of progress has been made.

International trade requires infrastructure in the form of transportation and communication networks.<sup>12</sup> Such networks must address a number of collective action issues – interoperability or interconnectedness, accidents and mishaps, jurisdictional rights, and competitive practices (Zacher, 1996). In international shipping, the International Maritime Organization oversees international trade and institutes conventions on accidents and accident prevention, innocent passage, pollution, and other concerns. The International Civil Aviation Organization enacts regulations to promote air traffic flows and to increase safety in the skies. For telecommunications, the International Telecommunication Union (ITU) establishes practices to curb signal interference and allocates the frequency bands of the electromagnetic spectrum to various specific purposes. In addition, the ITU promotes the adoption of standardized equipment. The Universal Postal Union enacts regulations that facilitate the free flow of mail and limits damage to this mail. In recent years, countries have cooperated as a means to coordinate actions in curbing monopoly power in the air travel, telecommunications, and shipping industries.

The successful creation of these infrastructures raises two crucial questions. Why has collective action worked for these supranational structures? Can these favorable influences be encouraged in areas where the needed infrastructure has not been forthcoming? A significant factor inducing nations to establish these international institutions and to submit to their regulations involves *mutual self-interests* in achieving the free flow of trade and communication among

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<sup>12</sup> An excellent treatment of regimes in shipping, air transport, postal services, and telecommunication is provided by Zacher

countries (Zacher, 1996). Although nations must sacrifice some autonomy over commerce and communications by satisfying these regulations, the true loss of autonomy is modest, meaning that the gain from the conventions does not have to be large to still provide each nation with a net gain. Since most nations already had similar regulations at home (e.g., allocating frequencies among alternative uses, procedures to avoid accidents at sea), the adoption of standardized practices did not mark much of a departure from the status quo. Furthermore, the above conventions have more to do with restricting the way that firms and individuals can act rather than with restricting the autonomy of the participating governments, which had to approve the conventions. By instituting common practices, these international regimes limited the transaction costs in addressing trade and communication impediments.

Another supporting factor involves the underlying game structure associated with adopting these practices. The adoption of standards represents a *coordination* game structure, which, unlike the Prisoner's Dilemma, does *not* have a dominant strategy of defection that provides greater payoffs regardless of the actions of others (see, e.g., Binmore, 1992; Farrell, 1987; Sandler, 1992). If there are just two players, each is better off by adopting a single standard, even if it is not his/her own, which gives the greatest payoff.<sup>13</sup> When there are  $n$  players deciding a standard, each player can still gain by adopting a *single* standard regardless of whose it is. This follows because the choice of multiple standards leads to lower payoffs for everyone than those associated with the  $n$  equilibria where just one standard is chosen.<sup>14</sup> The basic problem that arises

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(1996).

<sup>13</sup> This can be shown with the following two-player game in normal form:

		B:	
		Standard A	Standard B
Standard A	*	2,1	0,0
Standard B	*	0,0	1,2

where player A can choose either standard A, most favored by player A, or standard B, most favored by player B. If both players choose standard A, then player A receives 2 and player B receives 1. The payoffs are reversed between the two players when both choose standard B. When two different standards are chosen, each individual gets the lowest payoff of 0, so that coordination is in both players' interest. This game has no dominant strategy and two Nash equilibria in pure strategies — the cells marked with the asterisks. There is also a mixed-strategy equilibrium where each player randomly selects the other player's preferred standard one third of the time.

<sup>14</sup> Generalizing the game in footnote 13, we see that the adoption of the  $i$ th of  $n$  standards, one associated with each of  $n$  players,

is *how to coordinate* so that a single standard is picked. The role of an international institution is to focus attention on whichever standard appears best from a total payoff viewpoint. If more than one standard possess the greatest payoff, then the international institution must arbitrarily focus on one of them so as to orchestrate the required coordination (see later discussion on correlated equilibrium).

Collective action has worked in providing the necessary transnational infrastructure for telecommunications and transportation because nations all stood to gain, and, unlike transnational externalities such as global warming, unilateral defection did not benefit the defector. Perceived payoffs promoted cooperation and sticking with this cooperation. Furthermore, the necessary coordination was essentially an extension of the kinds of behavior that were already in place at the national level in most countries. This was, particularly, true among the major industrial countries which played an important leadership role in instituting these international organizations.<sup>15</sup> Transaction costs were limited, and the loss of national autonomy modest. If similar institutions are to be erected to facilitate other aspects of transnational trade and communications among nations, then similar underlying factors must be encouraged, which is not always possible. For example, controlling the arms trade can adversely influence the arms-trading countries, so that, unless they are compensated for their trade losses, they will not participate in directives restricting this trade and will covertly undermine the efforts of others.

Significant collective action challenges characterize the provision of infrastructure to address market failures at the supranational level. For illustration, consider the use of treaties, a common practice for dealing with environmental challenges. Typically, a transnational externality must first be identified. Once its cause is understood and its consequences are judged as sufficiently severe, countries will convene a meeting to frame a convention, which recognizes a potential problem and sets in motion efforts to evaluate the problem. If, as in the case of ozone-depleting substances, the problem is later seen to be real and to merit collective action, then a protocol is framed that pledges the ratifiers to act to alleviate the problem. Subsequent

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would give the *i*th player 2 and everyone else 1. The adoption of two or more standards would give everyone zero. In this scenario, the pure-strategy Nash equilibria are for exactly one standard to be adopted.

<sup>15</sup> On leadership, see Keohane (1984), Kindleberger (1986), and Young (1989). Effective leaders must be countries, which can have a large impact on the problem; hence Fiji cannot be an effective leader for global warming, but the United States can be an effective leader for peacekeeping.

amendments and protocols can follow if further actions are warranted.<sup>16</sup>

These protocols do little to provide for enforcement at the transnational level, requiring instead that countries do their own enforcement. If ratifying countries fail to live up to their commitments, negative world opinion is typically the punishment. Real enforcement requires that countries put in place a mechanism that can be used against them when they fail to achieve a treaty's stipulations. Such a mechanism threatens a ratifier's autonomy and would be costly to institute. Heckathorn (1989) notes that most collective action problems present two possibilities for free riding: at the agreement stage and at the enforcement stage. The latter stage often presents the potential participants with, on average, less incentive to overcome the free-rider problem.

Even successful treaties, such as the Montreal Protocol, experience enforcement problems that may require some form of supranational infrastructure. Although at the nation-state level the overwhelming majority of countries have imposed steep taxes on CFCs and other measures to foster the switchover to more benign substitutes, cheating has nevertheless occurred at the individual level. The smuggling of CFCs into the United States may in recent years be second to cocaine (*The Economist*, 1997, 48). To eliminate this challenge, the Montreal Protocol relies on a ratifier's customs officials to control smuggling at home, but these officials do not, however, have the authority or means to go after the source of supply abroad. Furthermore, these officials may be ill-equipped to address the level of smuggling. Some form of international enforcement is needed and this again raises issues about winners (i.e., countries hosting smugglers) and losers (i.e., all other countries) and the infringement of a nation's autonomy.

Treaty formation is a slow process, which, with the help of some infrastructure, could be streamlined. A good deal of time is taken up with first recognizing a contingency and then studying it before a protocol stipulates actions to be taken. Global and regional coordination would be a lot quicker if the global community permanently maintains a body of scientists, social scientists, statisticians, and medical experts to evaluate pending environmental and other concerns. Such a body would be comparatively inexpensive but could save the world community billions or more through faster and more decisive action when warranted. Such an infrastructure would only provide information for treaty making and would not constrain nations' participation decisions

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<sup>16</sup> Barrett (1998) identifies five distinct stages to treaty making that includes: (1) pre-negotiations or a cheap talk phase, (2) negotiations, (3) ratification, (4) implementation, and (5) renegotiation or periodic restructuring. Participants may differ at different

regarding supranational agreements. The Intergovernmental Panel of Climatic Change (IPCC) is serving such a role for global warming, while a proposed Intergovernmental Panel on Biodiversity, modeled after IPCC, would serve a similar role for species preservation. My proposal goes beyond these specific responses by instituting a broad-based permanent body of experts, who would continually monitor supranational contingencies and would not have to be created for specific problems so that action would be faster. Quicker action may mean that nations will have to do less than when a problem has been longer-term, and this smaller commitment also favors reaching an agreement.

Another supranational infrastructure requirement for the effective control of market failures involves finding a means to finance projects that support the expansion of international markets or the correction of market failures. To date, this financing has taken the form of membership fees and assessments paid to international organizations. Thus, the United Nations charges its members assigned shares of the cost of peacekeeping operations, whereas the International Monetary Fund assigns quotas to its members, creating a pool of resources that can be drawn upon by member countries with balance of payments problems. Funding requirements are currently tied to institutions addressing specific concerns; there is no general-fund financing based on income or indirect taxes. If nations impose a tax to control a transboundary externality, the proceeds go to the collecting country and are not necessarily used to alleviate the problem. This limitation in generating revenues at the supranational level inhibits the provision of infrastructure.

### *Correlating Strategies as a Supranational Infrastructure: A Novel Proposal*

An important message of this chapter is that the provision of public goods including supranational infrastructure can abide by diverse game structures. In the case of standards, we have seen that a coordination game structure with multiple Nash equilibria applies, while the provision of an enforcement mechanism involves a Prisoner's Dilemma. When multiple Nash equilibria occur, a central authority that can *correlate* the strategic choices of the agents can improve expected payoffs. In so doing, such correlation mechanisms can themselves be viewed as a form of supranational infrastructure for addressing market failures.<sup>17</sup>

To illustrate, consider a public good that abides by a best-shot technology for aggregating contributions (e.g., curing a disease). Suppose that each of two countries – *A* and *B* – can either contribute one or no units of the public good, in which only the first unit contributed gives a benefit of 6 to both countries at a cost of 3 to just the provider. In the game matrix of Figure 1, *A* is the row player and *B* is the column player. If a single country contributes, then it receives a net payoff of 3 when costs of 3 are deducted from the benefits of 6, while the noncontributor gets the free-rider payoff of 6. If neither nation contributes, payoffs are zero; if, however, both give, each receives 3 (= 6 - 3). There are two pure-strategy Nash equilibria, located at cells *b* and *c*, where just one nation contributes. The trick is to find a means to coordinate which country takes the action and which sits back. If a mixed-strategy equilibrium is employed, where nation *A* (*B*) contributes  $p$  ( $q$ ) percent of the time and does not contribute  $1 - p$  ( $1 - q$ ) percent of the time, then I can solve for the probabilities that make each nation indifferent between its strategies. In particular, I solve for the  $q$  and  $1 - q$  for nation *B* that gives nation *A* the same expected payoffs from its two strategies. Similarly, I find  $p$  and  $1 - p$  for nation *A* that gives nation *B* the same expected payoffs from its two strategies. These probabilities are  $p = q = 1/2$  for the game depicted. When this mixed strategy is used, each nation receives an expected payoff of 3.

Suppose that a coordinating apparatus randomizes between the strategy combinations in cells *b* and *c* with probabilities of 1/2, so that a probability of 0 is attached to cells *a* and *d*. The resulting correlated equilibrium gives an expected payoff of 4.5 (= 3/2 + 6/2), a marked improvement over the uncorrelated mixed-strategy Nash equilibrium. When multiple Nash

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<sup>17</sup> On correlated equilibria, see Arce (1997), Binmore (1992), and Fudenberg and Tirole (1991).



equilibria exist, correlated strategies may provide improved expected payoffs. The existence of a mechanism to coordinate actions when the players cannot be sure about the other players' actions can be a beneficial infrastructure for addressing some kinds of market failures. The entity doing the correlating can be a supranational institution or a third-party nation serving in a leadership capacity.

Figure 1. Best-Shot Assurance Game

A's Strategy \ B's Strategy	Contribute	Don't Contribute	
Contribute	a 3,3	* b 3,6	p
Don't Contribute	* c 6,3	d 0,0	1-p
	q	1-q	

In other instances, a coordinating mechanism can institute contractual arrangements that take a game devoid of a dominant strategy, such as an assurance game, and transform it into one with a dominant strategy. For an n-person assurance game with a threshold level of effort required before any benefits are received, Tabarrok (1998) has devised such a "dominant assurance contract" by offering compensation to players who contribute when the minimal level of cooperation is not achieved. This contractual arrangement can promote sufficient contributions so that the compensation does not, in fact, have to be paid. If institutional arrangements are conceptualized as alternative game structures, then efforts to correlate strategies or to introduce action-promoting contracts constitute novel forms of supranational infrastructure. The same applies to actions that foster networking among nations confronting market failures.

### 3. FACTORS INHIBITING THE PROVISION OF SUPRANATIONAL INFRASTRUCTURE

To understand how to promote supranational infrastructure, we must recognize factors that inhibit this infrastructure. If these impediments can be removed or circumvented, then progress can be achieved. For many supranational infrastructure scenarios, partial cooperation may be the likely outcome in which contributors are those nations that value the activity the greatest. Partial cooperation can be problematic when the reactions of the noncooperators are sufficient to offset the additional provision of the cooperators. Suppose that a set of nations put forward a mechanism to control their arms trade to unstable resource-rich regions as a means of reducing uncertainty and risks. If nonparticipants increase their arms production and sales,<sup>18</sup> then the welfare of the cooperators may be less than in the absence of cooperation as the additional costs of the cooperation do not outweigh the resulting enhanced-security benefits. In a world of identical nations, crucial factors determining the desirability of partial cooperation are the number of nonparticipants *and* their marginal reaction to an increase in the provision of infrastructure by the cooperators. The existence of a large number of nonparticipants with a large marginal reaction bodes badly for partial cooperation when actions of the nonparticipants can reduce the efforts of the cooperators (Buchholz, Haslbeck, and Sandler, 1998). Of course, some forms of infrastructure provision cannot be reduced by the nonparticipants. In the more realistic situation of heterogeneous nations, the *capacity* of the nonparticipants to offset or undo the cooperators' efforts, and not merely their numbers, is an essential consideration determining the success of partial cooperation. Thus, cooperative efforts by a few large nations to provide the required infrastructure may be sufficient despite a large number of noncooperators.

Another inhibitor of supranational infrastructure concerns its time profile of payoffs, involving large outlays of costs in the near-term, followed much later by benefits. If the government official making the decision applies a high discount rate, then these longer-run benefits must be quite substantial to give the decision maker a perceived net benefit from providing the infrastructure (see footnote 9). Countries with decision makers having relatively shorter time

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<sup>18</sup> These arms sales may be for profit or some legitimate political goal (e.g., defending human rights). Regardless of the reason, increased arms sales by nonparticipants offset efforts by the participants to curb such trade. Arms may find their way into "less legitimate" conflicts, unrelated to where they were sent; e.g., US arms sent to Afghanistan rebels are thought to have been used by terrorists against Western targets.

horizons in office would be less inclined to support infrastructure projects with deferred benefits, as a high discount rate results from the short time horizon. There is some evidence that specific autocracies have on average shorter lengths of rule than democracies (Bienen and van der Valle, 1989), and this consideration, if applicable, limits autocracies' support of some forms of supranational infrastructure. Insofar as this infrastructure may also siphon off tax revenues from an autocrat, who is interested in maximizing these revenues, this diversion of revenues may also limit an autocrat's support (see, e.g., McGuire and Olson, 1996).

Supranational infrastructure may also be hampered by large transaction costs, especially when large numbers of nations must be brought together. In the provision of a discrete public good which must be of a certain size, Dixit and Olson (1997) demonstrate that even a little transaction cost may be sufficient to keep a group from bargaining to an optimal provision decision. Supranational infrastructure often comes in a discrete size so that their two-stage analysis, involving both an agreement and provision stage, is frequently applicable. Moreover, the implication of partial cooperation indicates that a large number of participants are often needed to ensure that the providers of the infrastructure stand to gain.

Asymmetries may create further obstacles for supranational infrastructure intended to address market failures. An essential asymmetry may involve the presence of winners and losers for some kinds of transnational infrastructure. For instance, the institution of transnational crisis-management forces to address unrests that could destabilize neighboring countries may reduce the welfare of those countries that export revolutions abroad. Similarly, countries that anticipate a gain from some environmental contingencies, such as global warming (Caplan, Ellis, and Silva, 1998), may oppose efforts to facilitate treaty making which might ameliorate a problem that could favor them. Asymmetries in countries' endowments and tastes can have both positive and negative consequences on the supply of supranational infrastructure. If one or two large nations reap sufficient benefits from providing some forms of infrastructure, they may single-handedly do so. Such efforts may well characterize the US Center for Disease Control or US crisis-management efforts on a number of occasions. If these same countries are relied upon too often, fatigue may set in leading these nations to become unwilling to provide other forms of infrastructure at a later time. Another negative consequence may result if the provider designs the transnational infrastructure to serve its own national agenda. This hegemonic bias applied to the infrastructure

can alienate countries from using it, thus limiting its purpose. Such criticisms have been leveled at the International Monetary Fund and the World Bank regarding a US agenda. A strategic asymmetry may exist if one country or set of countries manages to move first in contributing to the infrastructure, thus making followers of the other countries. This first-mover advantage allows the leader, which will be the larger country, to shift more of the contribution burden onto the followers (Sandler, 1992). Hence, when a large country does not underwrite the entire investment itself, it may exercise a strategic advantage to get other countries to assume a large share of the burden.

Additionally, asymmetric information may also characterize the potential contributors to an infrastructure project, for which some are informed about the benefits and costs of a proposed undertaking and others are not, thus leading to a strategic asymmetry. Asymmetric information may involve an international institution (e.g., the United Nations) established to provide the infrastructure, thus creating a common-agency problem in which many principals (i.e., countries) must rely on the unobservable efforts of the agent institution. To motivate the agent to act properly, an incentive mechanism must be designed and such a mechanism will lead to agency costs which limit first-best outcomes and pays the agent positive rents in good states.

#### **4. MEANS FOR FOSTERING INFRASTRUCTURE PROVISION**

In promoting the provision of supranational infrastructure, effective policy must recognize that nation-states place a high value on their autonomy. When the desired infrastructure permits the ability to exclude nonpayers and to monitor utilization rates, then a club arrangement can be instituted that preserves nations' autonomy and that bases charges on benefits received. To illustrate, consider INTELSAT, a satellite communication network in geostationary orbit, some 22,300 miles above the equator, carrying the vast majority of transoceanic messages, including television, telephone, and other transmissions.<sup>19</sup> The INTELSAT communication system represents a club good, since access to the network can be restricted by coding and scrambling signals, and the network can be simultaneously used by its members. A properly designed toll internalizes the crowding externality, in terms of noise or interference, as an increased volume of signals share the same frequency band. For each unit of utilization (e.g., a minute of transmission), the per-unit toll

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<sup>19</sup> INTELSAT is described in further detail in INTELSAT (1995), Sandler (1997), and Sandler and Schulze (1981).

is equated to the marginal congestion costs and is equal for all members. Members, whose demands are greater, utilize the network more frequently and pay more in total tolls. Toll proceeds can reimburse capital expenditures and fund upgrades to the system. If, therefore, transnational infrastructure can be operated as a club, autonomous nations can support such infrastructure without the need of a supranational government. In fact, INTELSAT is a private consortium with firms and countries as members. LANDSAT, used for remote-sensing surveying, also operates as a private enterprise after the US government sold it to private interests. Thus, transnational infrastructure does not always have to be provided publicly, *especially when exclusion can be practiced*. Club arrangements fail for supranational infrastructure (e.g., peacekeeping, global warming) where benefits cannot be excluded from nonpayers.

To avoid some of the influences of asymmetries, it is essential that supranational institutions do not appear to be extensions of the richest nations. This avoidance can be facilitated if fees are not too concentrated on a few major nations. This insight is often ignored for real-world institutions (e.g., the United Nations, the World Bank, the International Monetary Fund). When, however, a few nations shoulder a disproportionate burden, these nations will push a national agenda in order to derive sufficient country-specific gains to justify their participation. In some cases (e.g., the World Bank), this asymmetric support is unavoidable because of the skewed distribution of world GDP. Nevertheless, if other moderate-size economies could be made to do more, then this disproportionate support and the undesirable consequences that come from it can be curtailed. The adverse influences of winners and losers from some kinds of infrastructure provision can be countered through side payments to the losers. The use of an international institution to coordinate contributions can, at times, eliminate first-mover advantages by making all actions by participants simultaneous.

An important procedure for curbing transaction costs is to maintain as much national autonomy as feasible when designing an institution that provides infrastructure at the transnational level. Nations view losses to their autonomy as costly transaction costs of engaging in international cooperation. Limits on these "interdependency costs" can foster the emergence of an institution (Sandler, 1997). As indicated above, clubs limit these losses in autonomy through a toll payment designed to increase in terms of total fees when a participant reveals a greater preference for the shared good through its utilization. Transaction costs are held in check so that the

institution is more likely to form when the institution is kept loose with infrequent meetings, a large consensus decision rule, and modest mandated fees. At times, these transaction costs can be held down by using an established transnational organization, already providing infrastructure, to supply other infrastructure requirements. This rationale is based on the sharing of common costs among two or more tasks, which, in turn, gives rise to economies of scope or a fall in the average cost per unit of an activity. Of course, these economies of scope can be eventually exhausted as additional infrastructure needs are served by the same organization.

From the study of public finance at the national level, we know that some means of collecting taxes or fees must be engineered to permit a supranational authority to finance a public input or good. For clubs, the revenues are the tolls; for international organizations, the revenues are either membership fees or special assessments. If members do not pay, then privileges can be curtailed or cut off. A treaty to curb pollutants usually relies on the ratifiers' abilities to impose taxes to curb pollutants. Some common funding for administering stipulations of the treaty (e.g., the Multilateral Fund of the Montreal Protocol) may be mandated, but such funding tends to be modest, so that the ratifiers' own taxing abilities are relied upon to meet treaty obligations. In the case of some transitional and emerging-market economies, this ability to collect taxes to provide the country's own infrastructure, let alone support supranational infrastructure, is very limited. For example, the problem plaguing the Russian economy during the last few years is due, in part, to its inability to collect taxes. Other such emerging-market economies face similar problems. A public finance system, which can collect revenues to finance public goods, social investment, and correct externalities, is a necessary infrastructure at both the national and transnational levels. As infrastructural needs at this latter level grow over time, some transnational sources of funding are required. A likely alternative would be to tax internationally traded items, since countries that trade obtain the greatest advantage from a well-functioning market economy with market failures controlled. Any taxes on these traded goods should be levied against the more inelastic goods to minimize excess burden.

There is also the issue of partial cooperation when addressing the provision of supranational infrastructure. A reasonable way to proceed is to entice the most important contributors on board, provided that their action can dwarf the collective response of noncontributors to undermine this cooperative action. To hold out until everyone joins may be

very costly in terms of losses in efficiency, and may give great leverage to the remaining nonparticipants to capture a large portion of efficiency gains (Dixit and Olson, 1997).

A related tax issue concerns whether or not redistributive taxes among countries at the transnational level could promote the provision of infrastructure with public good properties. Suppose that this redistribution is from small to large contributors, assuming that a public finance mechanism at the transnational level exists that could direct this transfer. The neutrality theorem indicates that such a redistribution could not change the level of the infrastructure if it is purely public (Cornes and Sandler, 1994, 1996). Next suppose that the tax is just imposed on the noncontributors so that they are made to support the efforts of the contributors. In this scenario, purely public infrastructure can be increased in a *Pareto-optimal fashion* if there are a large number of noncontributors, a high marginal value for the infrastructure by the noncontributors, and a limited aggregate free-riding response by contributors to this change in the purely public infrastructure (Cornes and Sandler, 1998). Thus, cooperation regarding infrastructure can be enhanced through taxes on noncontributors under some circumstances. When infrastructure is impurely public or possesses joint products, greater latitude for redistribution policies exists, but welfare implications of these redistributions are unknown.

Since the provision of transnational infrastructure presents a classic collective action problem, Olson's (1965) remedies may also prove efficacious. First, selective incentives to some of the potential contributors can change their underlying pattern of payoffs so as to support contributing. In some instances, the presence of nation-specific payoffs may make supporting an infrastructure project a self-enforcing dominant strategy. Clearly, the European Union's promotion of infrastructure in some member states have had significant country-specific payoffs (e.g., highways in Wales and the Republic of Ireland), while also providing some EU-wide benefits. Second, a federal structure may be useful, where the support of the infrastructure is first started at the regional level where values are more homogeneous, before being extended more widely. These regional pieces of infrastructure can then be linked to provide a transnational orientation, not unlike the way that national unions with their local chapters or the United Fund with its local organizations operate.

Supranational structure has, thus far, been analyzed from a static vantage point. In the real world of international transactions, situations are fluid. Technology may either create new forms

of infrastructure or else influence costs and benefits from instituting this infrastructure. Countries may break apart and new countries may form. Tastes of countries may change and so may leadership. Axelrod (1984) shows that cooperation may be achieved as an evolutionary process as high-payoff strategies are rewarded so that the share of cooperators in the population increases. When this is the case, supranational infrastructure will have less transaction costs and be easier to achieve. It is essential that any supranational infrastructure be reevaluated over time and updated when needed.<sup>20</sup>

## 5. CONCLUDING REMARKS

This paper analyzes the provision of infrastructure for improving market efficiency and correcting market failures at the transnational level. For telecommunications, postal services, and air travel, this infrastructure is primarily provided by international agencies because the required sacrifice in national autonomy is modest and participating nations receive a net gain from the infrastructure provided. When coordination is required, as in the adoption of industry standards, these international agencies can reduce uncertainty by focusing the nations on the action providing the largest payoff to the participants. This can be particularly useful when mixed strategies might be employed and/or multiple equilibria exist. Despite these successes, infrastructure for correcting market failures must clear significant hurdles from high transaction costs, partially cooperative responses, uncertainties, unfavorable incentive structures, and sundry asymmetries. Means for addressing some of these impediments are indicated. The collection of revenues to finance purely public infrastructure with nonexcludable benefits at the international level is, arguably, the greatest challenge that must be faced. Currently, international organizations and treaties rely on nations' internal taxes to provide fees, assessments, and to tax activities with negative transnational externalities. At the transnational level, some form of public finance that applies to international exchanges need to be instituted to underwrite transnational infrastructure to correct market failures.

If the international community gains insights into what has worked in the past when instituting other kinds of infrastructure, institutions can be designed to facilitate cooperation. Such

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<sup>20</sup> I thank Geoffrey Heal for this insight.



designs must account for nations' reluctance to sacrifice autonomy, transaction costs, the underlying incentive structure, and the time profile of benefits and costs. By altering these incentive structures, institutional arrangements can do much to promote better collective outcomes. Transnational institutions must resist the inclination to become too integrated and, in so doing, severely limit members' autonomy. If exclusion can be practiced, then clubs represent an institutional arrangement that can finance the infrastructure while preserving national autonomy. Informed policy making at the transnational level in providing infrastructure can result in picking up the "big bills left on the sidewalk" and enhance the wealth of the international community.

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